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FOOT-AND-MOUTH DISEASE

WITH SPECIAL REFERENCE TO THE OUTBREAK OF 1914

JOHN R. MOHLER

Chief of the Bureau of Animal Industry

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THE OUTBREAK OF 1914

A widespread outbreak of foot-and-mouth disease, discovered in the fall of 1914, proved to be the most serious and extensive that has ever occurred in the United States. The disease extended to 22 States and the District of Columbia. As may be seen from the map (fig. 1.), the infection spread over wide areas in the northeastern and north central parts of the country, and in places penetrated to the far Northwest. Previous visitations of foot-and-mouth disease in this country have been limited to comparatively small areas.

The outbreak was first located in the vicinity of Niles, Mich., in October, 1914, after it had evidently been under way since the preceding August. Unfortunately the mild form and atypical appearance of the first cases permitted the disease to spread without recognition to a considerable number of herds of cattle and hogs. Some of the latter reached and presumably infected the stockyards at

Chicago, from which the infection was disseminated to other stockyards and to points north, east, south, and west by shipments of livestock, especially stockers and feeders.

ORIGIN UNKNOWN

Many theories of the manner in which the infection was introduced into the United States have been advanced, and all of those which permitted of investigation have been diligently studied and disproved. Among those which have been thoroughly investigated with negative results are the introduction of the virus with smallpox vaccine from vaccine establishments in Michigan and Massachusetts, with calf-dysentery serum imported from Europe, by intentional dissemination of the disease by men equipped with hypodermic syringes, by imported hides, and by Belgian refugees, Russian immigrants, etc. There still remains one plausible theory which can neither be proved nor disproved, namely, the infection may have been introduced in merchandise brought to Niles, Mich., from South America which found its way into a hog lot and in due time caused the development of the disease in the hogs which were the first animals found infected.

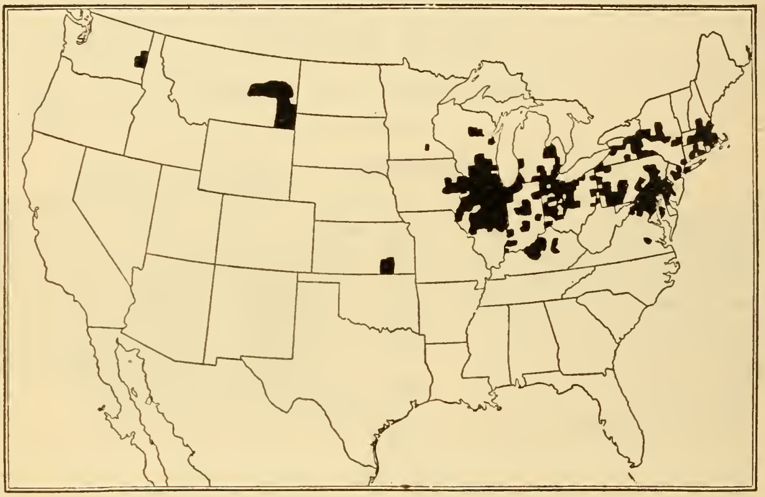

FIG. 1.—Distribution of infection in 1914 outbreak of foot-and-mouth disease, involving 22 States and the District of Columbia

HISTORY OF THE OUTBREAK

Two weeks after the first hogs became sick on the Michigan farm in August, 1914, the disease spread to the cattle on the same premises and simultaneously the cattle belonging to a neighbor developed peculiar symptoms. Each of the farmers called in a different local practitioner, one of whom several days later notified the State authorities of the conditions present and requested assistance. The first information that reached the Bureau of Animal Industry at Washington was a telegram from an assistant inspector at Detroit on September 3 stating that he intended to visit Niles, Mich., with the State veterinarian, at the latter's request, to investigate a possible outbreak of foot-and-mouth disease. Reports sent at this time to Washington stated there were no indications of foot-and-mouth disease but that the lesions were characteristic of necrotic stomatitis.

Nothing further was heard by the Washington office until October 10, when a letter arrived from the inspector in charge of the Detroit force stating that the disease had spread during the interval from the original two herds to six additional herds in the neighborhood. In this letter no diagnosis was made of the disease, but the history of the various herds was so completely described that no affection other than foot-and-mouth disease could suggest itself. Therefore Dr. Adolph Eichhorn, of the Pathological Division of the Bureau of Animal Industry, was sent immediately to investigate and report. Meanwhile the writer went to the bureau's experiment station at Bethesda, Md., and inoculated three calves with material from the affected animals, that had been received from the Detroit inspector. Each of the calves received an intravenous injection as well as an inoculation on the dental pad. On October 12 Doctor Eichhorn telegraphed that the clinical appearance was positive, and requesting that the writer be sent to Michigan to confirm the diagnosis. The Chief of the Bureau, Doctor Melvin, wired in return to Doctor Eichhorn instructing him to inoculate a calf and stating that Doctor Mohler was keeping the three calves inoculated at the experiment station under close observation, but would be sent to Michigan within 48 hours if no developments appeared. No symptoms of the disease had developed by this time in the calves at the experiment station and the writer accordingly proceeded to Niles, Mich., arriving there at 6.30 p. m. on October 15. He was met by Doctor Eichhorn and taken to an infected farm where an examination was made by the aid of an electric flashlight. After an examination of a number of the animals the writer agreed that it was indisputably the European foot-and-mouth disease and a report was wired to Washington that night to this effect and requesting additional men to assist in the work of eradication. Active scouting by all available veterinarians was started the next morning, October 16, and uncovered 39 infected herds in Michigan. On the following day, October 17, a number of additional infected herds were located in northern Indiana. A recommendation was made on that date that four counties—Berrien and Cass in Michigan and St. Joseph and Laporte in Indiana—be placed under quarantine, which became effective on October 19.

In this connection it is interesting to note that notwithstanding Berrien County all told had 191 infected herds, which is more than any other county in the country, the adjacent county of Cass never developed a single case of the disease. After the quarantine went into effect on these four counties rapid progress was being made in eliminating these centers of infection.

INFECTION OF CHICAGO STOCKYARDS

When the writer again visited Niles, on October 27, a report had just been received from Blissfield, Mich., that some steers from Chicago were sick. This was at once investigated in company with Michigan officials, and on arriving at Blissfield early the next morning, October 28, three of the steers were found to be infected with very acute lesions of foot-and-mouth disease; the others in the carload lot had not then developed any symptoms. As a result Lenawee and Monroe Counties, Mich., were quarantined, effective October 29.

The three infected steers referred to were in a carload lot that left Chicago nine days before, and it then became a question whether the Chicago stockyards were infected or whether the steers had been shipped in an infected car. Furthermore, this was the first intimation any one had that the Chicago yards might be infected, although certain individuals have evidently tried to give the impression that the bureau had knowledge of this shipment to Michigan prior to the opening of the National Dairy Show on October 22. Subsequently it was found that the three steers above mentioned reached Chicago in a lot of 49, the other 46 animals going to Chenoa, Ill., as one shipment, but they never developed any indications of foot-and-mouth disease, although examined frequently. This, at least, suggested that the three Blissfield steers picked up the infection outside of the Chicago stockyards and after they had been taken from the original shipment of 49 to complete the carload lot destined for Blissfield. While a thorough investigation failed to locate infection more definitely in the Chicago stockyards it was decided to take all precautionary measures and as a result an order was issued, effective October 31, quarantining the Union Stock Yards at Chicago.

At the time this order went into effect the National Dairy Show cattle were in the barns of the stockyards, having been held for observation by the State veterinarian of Illinois on October 29 at the request of the bureau, and in addition a large number of stockers and feeders as well as fat stock were in the pens at the yards. The day following the quarantine of the Chicago yards (November 1) a Holstein cow in the dairy show belonging to an exhibitor from Minnesota developed unmistakable lesions of foot-and-mouth disease, and two days later (November 3) several of the feeders which had been caught by the quarantine order and which were not purchased by the local packers for slaughter because of their slight value from a butcher's standpoint, likewise developed the disease. The discovery of these cases in the dairy-show barn and feeder section of the yards was the first knowledge any one had that foot-and-mouth disease existed in Chicago.

At this point the question naturally arises how and when did the Chicago yards become infected. It is impossible to make an accurate answer to either of these queries, but it is logical to assume that a shipment from the original infected area of certain livestock in the incubative stage of the disease was the responsible factor. Thus, when the tracing of cars began, it was disclosed that a mixed shipment containing 28 hogs, 3 cows, and 54 sheep had been sent on October 8 from the vicinity of Niles to Chicago. Almost simultaneously it was discovered that the milk from an infected herd had been taken to a creamery daily for the previous two weeks, and the infected skimmed milk that was returned to the patrons of this creamery resulted in the rapid spread and almost spontaneous appearance of the disease on 36 farms, which number increased to over

100 before the creamery could be closed. The hogs in the Chicago shipment were among the first to receive this contaminated skimmed milk, and their shipment to Chicago before the development of the disease probably infected the Union Stock Yards. Furthermore, the bureau learned of a number of instances where farmers and attendants from infected premises had visited the Chicago yards; and infection could easily have been carried by them to the yards, since the reverse (farmers carrying the disease to their cattle after visiting these yards) has been definitely proved in a number of cases.

As soon as the infected steers were found at Blissfield instructions were given to trace all shipments out of Chicago since October 1; but no disease was found until November 1, in Kane and Kendall Counties, Ill., in cattle which had left Chicago October 20 and 21, respectively. In fact, the evidence obtained as a result of tracing all shipments out of Chicago after October 1 clearly shows that no infection was carried prior to the time the Blissfield steers were shipped on October 19, which, as before mentioned, do not incriminate those yards, and that the greatest number of shipments which carried infection into Illinois, Iowa, Michigan, Wisconsin, Ohio, Kentucky, and Pennsylvania left Chicago on October 21, 22, 26, 27, 28, and 30.

As a direct result of the thorough work in following up all such shipments, the States of Illinois, Michigan, Indiana, and Pennsylvania were quarantined November 2; Maryland and New York, November 4; Ohio and Wisconsin on November 5; Iowa on November 6; and Montana on November 16. Massachusetts was also quarantined on November 6; Delaware, New Jersey, and Rhode Island on November 9; Connecticut on November 16; Loudoun County, Va., November 27; two counties in New Hampshire on December 1; four counties in Kansas on February 1; one county in West Virginia on March 1; two additional counties in Virginia on March 8; and one county in Minnesota on August 12.

TREATMENT OF DAIRY-SHOW CATTLE

In the 1908 outbreak all herds that became infected were slaughtered, and the same is true of the 1914 outbreak, with the exception of the cattle already referred to which were on exhibition at the National Dairy Show in Chicago when the disease broke out among them, on November 1, 1914. At this time it was the desire of the department to slaughter the first few animals which contracted the disease and to limit the spread of the infection to others by establishing hospital conditions, separating the herd into small units, and segregating these groups by means of partitions and muslin curtains saturated with bichloride of mercury solution, and other sanitary methods. This procedure was started but was abandoned after a brief period, as certain herdsmen adopted the German method of directly exposing the cattle under their supervision in order that the disease might run its course in all the animals as quickly as possible. In the meantime at the request of a committee of the National Dairy Show Exhibitors' Association the Secretary of Agriculture granted permission to the owners to retain their cattle under absolute quarantine until they had fully recovered from the disease and were not disseminators of the virus, which would be determined by experiments to be applied subsequently.

Before starting these tests it was the desire to move the cattle farther away from the Chicago stockyards and arrangements for their removal to the Hawthorne race track near Cicero, Ill., were completed on December 26. An inspection of the animals at that time revealed no cases of foot-and-mouth disease. Only a few cases of various forms of ailment such as articular rheumatism, pulmonary disturbances, and mastitis were observed. Five cases of mastitis, however, still persisted, and these, together with two tuberculin reactors, were destroyed prior to the moving of the cattle.

In order to prevent the introduction of virus into the new quarters so far as possible it was decided to spray and scrub the animals with a 3 per cent cresol solution. They were then taken through a foot bath into a separate stable which had been previously cleaned and disinfected with a 6 per cent solution of cresol. The animals were then dried with towels, left there all night, and the next morning loaded into special box cars in which they were conveyed directly to their new quarters at Hawthorne Park. The same care was exercised with regard to the attendants; all their belongings and clothes were disinfected and fumigated, their shoes disinfected, and the men themselves required to bathe and change to clean linen. At Hawthorne every precaution was used in unloading in order that no infection would be scattered and the grounds were guarded by deputy sheriffs during the entire period of quarantine.

It is not intended to go into details of the quarantine of the dairy-show herd, but it should be of interest to record the experiment which proved that the cattle in the herd had fully recovered. Since the publications of Loeffler in 1904 it has been known that certain animals which recover from foot-and-mouth disease may act as carriers of the virus for a considerable period, precisely like persons who act as bacillus carriers for long periods after recovery from typhoid fever, cholera, and diphtheria. Such virus carriers, therefore, must be considered a constant menace to the eradication of the disease when only quarantine measures are adopted.

Professor Bang, in a personal letter (1915), writes:

> I believe that recovered cows very often retain the virus—probably in the clefts (fissures or crevices) in the hoofs, especially in the large flat cavity which often has been formed under the sole and where infected particles of manure can be retained for a long time and be freed after months, when the hoof is worn. We have this year very often had the case that in the summer time the cows in the stable have had foot-and-mouth disease, while heifers and calves were on grass and did not get affected. Late in the autumn they were put into the stable, and a month or two later the disease began. This may be the consequence of a less good disinfection of the stable, but it seems as likely that the virus comes from the recovered cows. In my opinion, the disinfection of the hoofs ought to be done very carefully, but that is indeed very difficult. All loose horn ought to be removed.

Even though such cases are rare, it has been the exceptional cases which the United States Bureau of Animal Industry has always attempted to locate and eliminate, since such cases are the ones that have always caused trouble. Those exceptional cases which act as virus carriers have been held responsible by a number of authorities, including Loeffler, for the recrudescence of the disease in portions of Germany, and in the eradication of this disease the exceptional cases must not be ignored. A single instance of this kind may prove disastrous and result in a new outbreak of the infection.

In order to ascertain whether any such virus carriers existed among the animals of the National Dairy Show, 50 head of healthy young cattle which had been secured for this purpose were placed in contact with them on March 25. These test animals consisted of 34 steers and 16 heifers, ranging in age from 1 year to 18 months. The tests, which were conducted by veterinarians from the Bureau of Animal Industry, included inoculation of the saliva, feces, urine, vaginal discharges and hoof scrapings, feeding of milk, and manure and direct-exposure tests. In the exposure tests one susceptible animal was placed between two recovered show cattle and kept there for 48 to 64 hours, then changed and placed between two other recovered animals. This was done until all recovered animals had been given an opportunity to infect the susceptible animals and was repeated three times, so that each recovered animal gave 144 hours of exposure to the test animals. At the same time the recovered herd was divided into 48 groups of approximately 15 animals each. From every animal of each group a small quantity of feces was collected, mixed with water, strained, and a cheesecloth saturated with the strained fluid. This cloth was then rubbed into the buccal cavity of the susceptible animals. If in the following seven days no indications of foot-and-mouth disease developed in any of the test animals, the same grouping of the show cattle followed for subsequent tests, which were undertaken in turn with saliva, urine, vaginal discharges, milk, and scrapings from the interdigital space and around the coronary band of each recovered animal. During the execution of these tests it was considered advisable to remove only a sufficient quantity of the manure and litter to prevent undue accumulation and to assure satisfactory sanitation, the object being to afford the susceptible animals an opportunity for infection with the virus if such should be present in the feces. These tests continued until May 9. On April 8, 50 hogs were placed in temporary pens within the inclosure and fed on milk from the show cows and also allowed to consume the leavings and droppings from the cattle.

As a result of these tests no lesions of foot-and-mouth disease were produced, nor were there witnessed any of the dire results predicted, such as the production of tetanus, malignant edema, blackleg, necrosis, pyemia, septicemia, etc. On May 31, three weeks after the last inoculation test and seven months after the show cattle had been placed under quarantine, they were released by the Federal Government and permitted to move interstate subject to the regulations of the States at destination. At the beginning of the tests on March 25, 747 animals were included in the number quarantined. On May 30, at the conclusion of the tests, this number had been increased to 752 by the addition of a number of calves.

The conditions under which these show cattle were kept and the sanitary quarters in which they were confined during the period of quarantine would be almost impossible to duplicate under ordinary farm conditions, while the large number of animals proportionately reduced the average cost of quarantine. Added to this, conditions permitted the removal of these animals from the infected barn and surroundings at the Union Stock Yards to the clean and sanitary quarters at Hawthorne at a very suitable time. That no virus carriers were demonstrated to exist in this herd is a definitely established fact, but this does not prove that such virus carriers would not exist in other herds under like or unlike conditions. It is, however, a source of gratification to this department as well as to the public that conditions allowed these valuable animals to be preserved by the methods adopted.

CONTAMINATION OF HOG-CHOLERA VIRUS

Early in November, 1914, it was ascertained that the products of a certain hog-cholera serum company in Chicago had become infected with the virus of foot-and-mouth disease. A careful investigation developed the fact that while no serum shipped out from the plant of this company was contaminated with foot-and-mouth disease, one lot of virus was so contaminated. This lot of virus was comparatively small, it being composed of 3,400 cubic centimeters of blood obtained from four pigs. These pigs were not sick at the time they entered the establishment, on October 16. They were then inoculated with hog-cholera virus with the intention of using their blood in connection with administering the serum-simultaneous treatment. On October 26 these hogs were killed to furnish hog-cholera virus.

The lesions found in these four pigs were only those of acute hog cholera, but evidently they were also in the incubative stage of foot-and-mouth disease. It is a well-known fact that the virus of foot-and-mouth disease is present in the blood only in diluted quantities, and then only at the beginning of the fever, before the vesicular eruptions appear. When hogs are killed at this stage the blood will carry the virus of foot-and-mouth disease without possibility of detection except by animal inoculations. The blood from these pigs was mixed and most of it shipped out to customers of the concern in Ohio, Indiana, Illinois, and Iowa. On November 3 the inspector in charge of the plant had his suspicions aroused by sickness appearing in certain hyperimmunized hogs. This was late in the day, and he visited the plant at daylight on November 4. He immediately quarantined the plant for foot-and-mouth disease, because the hogs noticed sick the evening before were worse and showed lesions of foot-and-mouth disease. All the employees and the entire establishment were disinfected. The infection of the plant was due either to the promiscuous passing of the owners and employees of the company to and from the infected Chicago stockyards or to the purchase of hogs exposed in those yards.

SOURCES OF INFECTION

Table 1 shows the number of herds slaughtered in each State, together with the probable methods by which infection was transmitted:

TABLE 1.—*Herds slaughtered in each State, together with the probable methods by which infection was transmitted*

Source of infection	Number of herds slaughtered											
	Connecticut	Delaware	District of Columbia	Illinois	Indiana	Iowa	Kansas	Kentucky	Maryland	Massachusetts	Michigan	Minnesota
1. Through animals brought direct from infected public stockyards for slaughter, feeding, breeding, or dairy purposes	2	2	----	89	19	9	----	24	19	25	29	----
2. Through animals brought from infected stables or lots of local dealers	21	----	----	60	4	----	----	12	14	17	2	----
3. Through direct contact with neighboring infected herds, by pasture, mating, breeding animals, or animals not confined	4	6	1	173	8	13	----	31	8	6	9	----
4. Through infected railway cars	----	----	----	29	----	----	----	----	----	----	1	----
5. From creameries	----	----	----	35	----	----	----	----	----	----	21	----
6. From treatment with infected hog-cholera virus or serum	----	----	----	94	5	2	----	----	----	----	----	1
7. Through persons—												
(*a*) Neighborhood visiting, exchanging work, etc	3	----	1	247	14	9	4	8	6	18	2	----
(*b*) Through local practitioners or dairy inspectors	----	----	----	20	1	----	----	1	2	3	----	----
(*c*) By stock buyers, peddlers, etc	----	----	1	55	----	3	----	----	5	8	----	----
8. Through dogs, poultry, birds, etc	----	----	----	112	----	7	2	----	4	3	2	----
9. Through infected public highways	----	3	----	10	----	----	----	----	----	----	----	----
10. Through contaminated streams or drinking water	----	----	----	11	----	----	2	----	----	1	----	----
11. Through infected feed or garbage	1	----	----	----	1	----	----	----	----	3	----	----
12. Other known sources of infection	----	----	----	7	1	----	----	----	1	2	----	----
13. Sources of infection unknown	4	1	1	284	65	6	4	6	11	17	206	----
Total	35	12	4	1,226	118	49	12	82	70	103	272	01

Source of infection	Number of herds slaughtered											
	Montana	New Hampshire	New Jersey	New York	Ohio	Pennsylvania	Rhode Island	Virginia	Washington	West Virginia	Wisconsin	Total
1. Through animals brought direct from infected public stockyards for slaughter, feeding, breeding, or dairy purposes	4	----	21	45	94	289	19	4	1	----	10	705
2. Through animals brought from infected stables or lots of local dealers	----	1	----	15	25	121	9	3	----	18	3	325
3. Through direct contact with neighboring infected herds, by pasture, mating, breeding animals, or animals not confined	25	----	2	9	29	65	13	----	----	----	2	404
4. Through infected railway cars	----	----	----	4	----	1	----	----	----	----	----	35
5. From creameries	----	----	----	33	2	86	----	----	----	----	2	179
6. From treatment with infected hog-cholera virus or serum	----	----	----	----	20	----	----	----	----	----	----	122
7. Through persons—												
(*a*) Neighborhood visiting, exchanging work, etc	5	1	15	21	25	119	4	----	----	2	5	509
(*b*) Through local practitioners or dairy inspectors	----	----	----	----	----	24	----	----	----	----	----	51
(*c*) By stock buyers, peddlers, etc	----	----	----	12	4	18	5	----	----	----	1	112
8. Through dogs, poultry, birds, etc	----	----	----	8	5	9	7	----	----	----	11	170
9. Through infected public highways	----	----	----	----	3	8	----	----	----	----	----	24
10. Through contaminated streams or drinking water	----	----	----	----	3	12	----	----	----	----	----	29
11. Through infected feed or garbage	----	----	5	1	1	9	1	----	----	----	----	22
12. Other known sources of infection	----	----	1	26	2	13	----	1	----	1	----	55
13. Sources of infection unknown	8	1	8	45	15	118	1	1	----	6	6	814
Total	42	3	52	219	228	892	59	9	1	27	40	3,556

The figures in Table 1 are compiled from statistics gathered in the field by the veterinarians engaged in the active work of eradication. Every effort has been made to obtain an accurate knowledge of the means by which infection was introduced into a herd, and while it is probable that some slight errors have been made, they would not materially affect the total results as given. It will be observed that the two most important factors in the spread of the infection were public stockyards and human beings. The transmission by the former method may be readily controlled by regulations, but the spread of infection by persons offers many serious difficulties.

Of the 13 items in the Tables 1, 2, and 3 are self-explanatory. Under item 4, however, should doubtless be added a number of cases charged under item 1. In a considerable number of cases animals shipped from stockyards, apparently healthy when shipped and unloaded but afterwards developing the disease, may have received the infection from the cars while in transit instead of at the stockyards from which they were shipped. As soon as the outbreak was discovered, however, the disinfection of stock cars was ordered, and it is not probable that many such cases happened after that date.

Under item 5, "From creameries," infection was chiefly carried to these creameries by milk from infected cows and disseminated by the feeding of skim milk to other animals. It is evident that the number of such infections in Michigan is entirely too small, since about half of the unknown sources of infection in that State, especially in Berrien County, were closely connected with infected creameries, but they have not been so tabulated because the evidence was not sufficiently conclusive. As foot-and-mouth disease is not the only epizootic which is spread in this manner, need is shown for legislation requiring creameries to pasteurize skim milk sent out for animal feeding.

Item 6, "Treatment with infected virus or serum," is explained elsewhere in this circular. A careful investigation was made by the bureau, which resulted in the finding that all infections prior to August 8, 1915, were contained in the virus and not in the serum with which the animals were treated, but after August 8, 1915, one lot of hog-cholera serum was also found contaminated. A glance at the table shows the five States to which this virus and serum were shipped.

Item 7, "Through persons," including (*a*), (*b*), and (*c*), presents one of the most interesting features of the entire outbreak. Out of a total of 3,556 infected herds, 672 were infected through virus carried upon the shoes, clothing, or bodies of persons. Of the 814 "unknown" cases, it is probable that a considerable proportion were infected in this way, making more than 1 out of every 6 of the total infections the result of this method of transmission. No stronger argument could be presented for the necessity of maintaining an armed guard on quarantined premises. Of the 51 cases transmitted by practitioners and dairy inspectors, the larger part of the number occurred early in the outbreak, before knowledge of it existed. Although the most careful investigation has been made, no case has been found wherein the State or Federal inspectors engaged in the work of eradication have carried infection on their clothing or persons. This is due to the painstaking method of disinfection and fumigation enforced by the department and the various States, and which is described in another part of this circular.

Under item 8, crows seem to have been the chief carriers among the birds, and careful study of their habits by a number of inspectors brought out some interesting facts in this connection. In one instance a flock of crows was followed by telephone and automobile for a distance of 35 miles. The habits of these birds in flying from place to place, alighting in cattle and hog yards and running over the ground picking up small bits of manure or litter upon their feet, show how easily they may become carriers of such intensely infectious diseases.

Under item 10 no cases have been shown wherein infection was carried for any distance by streams, although litter has been carried to near-by pastures.

Item 11, "Infected feed or garbage," includes a number of cases where swine have been fed offal from slaughterhouses, later found to have been infected.

Under item 12, "Other known sources," is included 12 cases of reinfection on infected farms, after slaughter and disinfection. While this percentage is very small, careful inquiry was made as to the probable cause of such reinfection. Printed reports covering the disinfection and restocking of these premises were requested of all inspectors in charge of reinfected premises. This investigation disclosed the fact that in each instance the work of disinfection was conducted on these premises during very cold weather, or at a time when snow and slush covered the infected ground. In this way virus which had been tramped into the ground or had lodged in concealed corners was protected from the action of the disinfectants used. Later on, as the weather grew warm and the premises were restocked, this virus was uncovered and was the source of infection.

Among other known sources are included: Railroads passing through or near farms, permitting infected litter to fall from cars; the use of feed bags from infected premises; skim milk from a community dairy plant; use of milk utensils that had been on infected premises, etc.

Under item 13, "Unknown," 814 cases are placed. Of this number 271, or one-third, are in Michigan and Indiana, and are chiefly cases which became infected before the work of eradication was started. While about half of the latter are believed to be due to creamery infection, the remainder were probably carried in almost every known way, and if added to the number under the proper item would hardly change the ratio of the entire table. Many of the herds carried under this item in other States doubtless became infected through the activities of persons in visiting other infected premises, but this could not be established by the inspectors. To this item, too, must be added many cases of infection carried by birds, rats, and other small animals, of whose movements no records could be kept.

SUSCEPTIBILITY OF SWINE

The susceptibility of swine to foot-and-mouth disease was thoroughly demonstrated during the 1914 outbreak, and the tendency of these animals to have the disease in a mild and atypical form resulted in numerous unpleasant complications and extensions of the infection. The lesions of this disease in swine are not always readily discovered by the casual observer. Stomatitis, especially in the necrotic form, is a common sequence of hog cholera, while traumatisms of the feet, especially contusions of the plantar cushion, are frequent in swine that have been driven or shipped. For these reasons little attention is paid by the owners of swine to these symptoms, and unless the herd is located within suspicious territory the disease may continue in a chronic form for a considerable length of time before discovery. The danger, of course, lies in the ability of these animals to disseminate the disease.

This is the condition which existed at the beginning of the outbreak in Michigan, later permitting the infection of the Chicago and other stockyards, still later found to exist among large numbers of swine in the outskirts of Philadelphia, which was responsible for a new outbreak after all territory was believed to be free from the disease.

On July 29, 1915, foot-and-mouth disease was discovered to exist in a herd of 20 cattle within the city limits of Hornell, Steuben County, N. Y. As no known cases of the disease had previously been found within a radius of over 75 miles, the source of the infection remained a mystery until two days later, when 125 hogs, divided among five herds, were found infected within a half mile of the first-discovered premises. These hogs had evidently had the disease in a mild form for a considerable length of time, as new horn on all four feet of many hogs had grown halfway down. Infection had been carried from these hogs to the cattle through drainage.

As no previous infection had been discovered on a farm since May 11, and in a slaughterhouse since June 16, the report came as an unpleasant surprise, but emphasized again the need for continued careful supervision of all livestock in previously infected areas, especially large herds of swine.

On August 8, 1915, another herd containing 24 cattle and 3 hogs was found infected in Steuben County, 20 miles south of the infected farms above mentioned. The owner of the former farm had motored to the vicinity of these farms eight days before his cattle developed the disease, which is the only plausible explanation of the source of this infection. The milk from this herd was used by a cheese factory with 44 patrons, and farms of the latter were located and systematically inspected, but no further development of the disease was found.

On the same date, August 8, foot-and-mouth disease was discovered among 119 hogs and 4 cattle at Wheeling, Cook County, Ill., 22 miles north of Chicago. Suspicion was at once cast upon a batch of hog-cholera serum which had been prepared in Chicago the previous October at an establishment where the disease was not known to exist at any time. The serum was kept in cold storage, preserved in 0.5 per cent carbolic acid, and not used until after the quarantine restrictions had been removed and following the negative test experiments on 10 hogs. This batch of serum was used in six Illinois counties and one county each in Indiana, Michigan, and Minnesota. The hogs in the Minnesota county and in four of the Illinois counties developed the disease by August 11 and were disposed of in the regular manner. The hogs in the Michigan county were appraised, slaughtered, and the premises disinfected before the disease developed in order to prevent the occurrence of new centers of infection. This procedure was also followed in the two remaining Illinois counties, but the State officials of Indiana refused to adopt this recommendation, with the result that hogs treated with hog-cholera serum in Posey County, Ind., developed foot-and-mouth disease on August 16.

The recurrence of the disease in Illinois and Indiana and its appearance in Minnesota were finally and definitely traced to the hog-cholera serum above mentioned, although this serum had been thoroughly tested before it was permitted to be placed upon the market, which tests failed to reveal any evidence of contamination. Subsequently additional samples of the serum were tested again and again, but it was not until the sixty-second animal used in the fifth series of tests had been inoculated with the serum that symptoms and lesions of foot-and-mouth disease were produced. This animal, a calf, received 30 cubic centimeters of the suspected serum, and the diagnosis was subsequently confirmed by inoculation of other animals with the material from this infected calf.

METHODS OF ERADICATING FOOT-AND-MOUTH DISEASE

The methods of eradication applicable to foot-and-mouth disease include: (1) Immunization; (2) quarantine and disinfection; (3) slaughter and disinfection. Each will be discussed in the order named.

IMMUNIZATION

Immunization in the 1914 outbreak was out of the question, as the only serum thus far produced gives but a passing immunity of only a few weeks' duration, unstable at best, and impossible to obtain in this country or in sufficient quantities in any country. To Professor Loeffler, of Germany, more than to any other, we owe our present knowledge relative to the effects of serum immunization for foot-and-mouth disease. Ever since he was placed in charge of the laboratories for the investigation of foot-and-mouth disease the bureau has carefully followed his work. His publications on the subject, and particularly those referring to immunization against the disease, have appeared at various intervals and have been the subject of discussion at several international veterinary congresses. While his work on the serum treatment of this disease is of great scientific interest, its practical value has not yet been proved. In the 1914 annual veterinary report of the Prussian Government a detailed description is given of a series of experiments which were undertaken to establish the value of the serum prepared by Professor Loeffler's method under his own supervision in the Government laboratories on the island of Riems, in the Baltic Sea.

These experiments proved that the serum does not protect animals in small doses (20 to 30 cubic centimeters), but large doses with repeated injections afforded a protection to the animals and might be employed in the eradication work when control of the disease by quarantine measures is attempted. In the partly successful experiments animals over 3 months old received four injections of serum at intervals of 10 to 14 days. The first injection consisted of 200 cubic centimeters and the subsequent ones 60, 30, and 30 cubic centimeters, respectively. This large quantity of serum makes the cost of protection under ordinary circumstances prohibitive. It should also be considered that even in these experiments 6 to 8 per cent of failures occurred, and it must be recognized that in a country like the United States with so many highly susceptible animals a single failure of protection might prove to be the source of a new outbreak. Moreover, the immunity furnished is of quite short duration, lasting only from two to three weeks.

Another disadvantage is that the preparation of the serum requires a propagation of the foot-and-mouth disease virus, and its presence in this country would be a constant menace to the stock industry, even with the exercise of the greatest precaution and care. Livestock conditions prevailing in the United States would also make the serum immunization extremely difficult, if not impossible. The shipment of stock over long distances, particularly the shipments radiating in all directions from stock centers, would necessitate the protection of a large percentage of the stock in the country, or at least in an extensive area. This, with Loeffler's method of serum production, would be impossible.

Not until a more practical method of immunization has been discovered will it be possible to utilize it for the successful eradication of foot-and-mouth disease in the United States or any other country.

QUARANTINE AND DISINFECTION

It has long been maintained that the method of quarantine without slaughter is a possible means of eradication but one which by its very nature admits of a greater spread of infection. As will be shown elsewhere in this circular, foot-and-mouth disease has been combated by quarantine and disinfection in certain European countries for many years. The constant recurrence and widespread dissemination of the infection in these countries prove conclusively that these measures have been unsuccessful. In fact, Professor Loeffler, in one of his last papers on foot-and-mouth disease, states:

> Likewise the second means, the strict carrying out of police and veterinary restrictions, while very frequently it had brought good results, has not prevented the spread of the disease.

The necessity for an absolute quarantine in a disease so easily transmitted is apparent, and this has been found impossible, even in Germany, where military support is given to a well-organized veterinary police system. Indeed, every European country which now has the disease hopelessly fastened upon it has permitted the condition to exist through this very system of attempted eradication. As a result the infection has become so widely distributed in many of these countries that the authorities are forced to accept this measure of control as the only available and economic method under the present conditions.

The infective agent may be spread so readily that it is difficult to prevent its dissemination even where animals are confined in tight sanitary buildings with the most careful use of disinfectants and surrounded by guards, a method entirely impracticable on the average farm and nearly always much more expensive than the value of the average animal so quarantined. Added to these objections is the greater one of known failure in all countries where this method has been tried.

SLAUGHTER AND DISINFECTION

With our present knowledge, slaughter and disinfection is the only satisfactory and economic measure for controlling foot-and-mouth disease in a country like the United States, where the infection is not indigenous. All authorities on the subject agreed on this point in their respective reports to the Tenth International Veterinary Congress at London, September, 1914. Thus we have the report of Professor Mettam, principal of the Royal Veterinary College of Ireland, who states:

> Efforts should be promptly made to eradicate the infected centers. The animals affected and those which have been directly and indirectly in contact and which must be considered as probably infected are slaughtered.

Professor Remmelts, of Holland, also claims that—

> Preference must by far be given to the immediate removal of virus by slaughtering diseased and suspected animals than to any other measure.

Leclainche, a representative of the French Government at this congress, likewise advocates the slaughter of diseased and exposed animals in cases where the infection has not become firmly implanted and where natural boundaries are present.

Nevermann, the highest veterinary official of Germany, states in his conclusion that—

> The slaughter of infected herds in Germany has proved an advantageous method of fighting the disease under certain conditions.

Earlier in his article he states:

> With their slaughter, newly appearing outbreaks may be readily controlled, and thereby the harmful spread from such outbreaks may be avoided. I desire particularly to call attention to the magnificent results of this method attained in England and the United States.

Furthermore, paragraphs 159 and 160 of the German regulations, issued in 1911, specifically provide for the slaughter of all infected or suspected cattle when foot-and-mouth disease occurs in otherwise healthy or noninfected localities, and provisions are made covering the method of such slaughter, the disposal of the parts of the carcass, hides, and horns, the manner of disinfecting the premises following the slaughter, and the precautions to be observed in disinfecting those taking part in the slaughter before they leave the farm.

An article by the venerable Professor Guillebau in the Swiss Veterinary Journal, 1915, claims that eradication by slaughter in the lowlands of Switzerland is indicated but not so in the mountains.

Other authorities might be quoted, but the consensus of opinion is that in a locality where it is possible to control the disease by slaughter this method should be given preference over any other.

In view of these facts and the results achieved in the 1914 and former outbreaks of the disease in the United States it is beyond question that the measures pursued in this country were the most suitable for the conditions, especially so when the danger from virus carriers is given due consideration. And it would be desirable for legislative bodies and others to reflect that the kind of cooperation that checked and suppressed one of the most infectious animal diseases in the world can be used effectively against other enemies of the livestock industry. Notwithstanding this, certain critics of the bureau have made similar attacks on the foot-and-mouth eradication work as they did years ago against contagious pleuropneumonia control work. Were these criticisms to be heeded, foot-and-mouth disease would unquestionably be permanently saddled on this country.

DETAILS OF ERADICATION MEASURES, 1914

The following details of the procedure in the 1914 campaign of eradication show the methods which the accumulated experience of the Bureau of Animal Industry has found most expedient for the speedy and thorough prosecution of the work.

INITIAL PROCEDURES

As soon as foot-and-mouth disease had been discovered and the diagnosis confirmed, the proper State authorities and the Bureau of Animal Industry designated qualified veterinarians to take charge of the work of eradication for their respective governments. These inspectors in charge promptly requested sufficient supplies and necessary help from the head offices and cooperated from the beginning in ascertaining the extent of the outbreak, as well as in formulating and enforcing quarantine regulations. The State authorities were requested to quarantine the infected premises immediately and to place a guard on each of such premises day and night to see that the quarantine was enforced. The owners of the affected herds were fully instructed concerning the nature of the disease and the importance of maintaining a strict quarantine. The owners of adjacent farms were similarly notified and instructed in order that they would take precautions to protect their herds against infection. The stockyards in the infected districts were closed immediately and creameries and cheese factories investigated to see that skim milk, buttermilk, and whey were being properly sterilized before returned to farmers; otherwise they also were closed. The widest publicity was given to the outbreak from the beginning through the daily papers and the distribution of posters, special circulars, and similar literature. Public meetings of farmers and stockmen from the territory bordering the infected area were called to discuss foot-and-mouth disease and methods to be used in eradicating it, with particular reference to the duties of livestock owners and what would be expected of them. Stock owners from infected farms or adjacent premises were discouraged from attending these meetings because of the danger of carrying the infection on their persons; all necessary information was given to them by inspectors making farm-to-farm inspections. The veterinary inspector in charge of this work requested representatives of State authorities, members of livestock associations, and interested livestock owners of the community to speak at these meetings.

Arrangements were made immediately for the transportation of employees and their equipment so there would be no delay when the assistants arrived. As soon as an expert on car tracing arrived a report was secured of all livestock shipments that had been made from the community since the disease appeared. All suspicious shipments were traced to destination and back to the farm where the stock originated to ascertain whether there was any probability that they were infected when shipped. These precautions were taken to limit the spread of the disease as quickly as possible.

The veterinary inspectors located at various public stockyards were informed immediately by telephone or telegraph of any diseased, suspicious, or exposed animals that were shipped from the infected community to public stockyards. A record was made of all stock cars that carried infected or exposed animals out of the infected district, and arrangements made with the various railroad companies for the cleaning and disinfecting of such cars before they were again used. Veterinary inspectors were detailed immediately to scout in the community wherever rumor or suspicion led in order to locate and quarantine all infected herds as soon as possible. In addition to the scouts, other veterinary inspectors were detailed to make a careful systematic inspection of all livestock within a radius of 3 miles or more of any infected premises. In cases where foot-and-mouth disease was reported by one veterinary inspector the diagnosis was confirmed by at least one other veterinary inspector.

QUARANTINE MEASURES

As the eradication work advanced, it was found advisable to maintain several different quarantine measures in the infected States, and for the purpose of aiding in the recognition of these restrictions the following definitions were enacted:

Quarantine area.—Any State or any portion thereof quarantined for foot-and-mouth disease in livestock.

Closed area.—Those portions of the quarantine area into which the interstate movement[1] of cattle, sheep, other ruminants, and swine is permitted for immediate slaughter only, and from which the interstate and foreign movement of such animals is absolutely prohibited, and the movement of the dressed carcasses of such animals, the hides, skin, wool, hair, horns, or hoofs of such animals, and of hay, straw, similar fodder, manure, litter, or bags or similar containers which have been used for stock feed is restricted.

Exposed area.—Those portions of the quarantined area from which the interstate movement of cattle, sheep, other ruminants, and swine is permitted for immediate slaughter after inspection and certification, and into which such animals may be moved for any purpose; also from which the interstate and foreign movement of the dressed carcasses of such animals, the hides, skins, wool, hair, horns, or hoofs of such animals, and of hay, straw, or similar fodder, manure, litter, or bags or similar containers which have been used for stock feed is restricted.

Modified area.—Those portions of the quarantined area from which the interstate movement of cattle, sheep, other ruminants, and swine is permitted for immediate slaughter without inspection to points in the quarantined area, and into which such animals may be moved for any purpose, also from which interstate and foreign movement of the dressed carcasses of such animals, the hides, skins, wool, hair, horns, and hoofs of such animals, and of hay, straw, or similar fodder, manure, litter, or bags or similar containers which have been used for stock feed is permitted without any restrictions whatever.

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[1] Movement of livestock within States is subject to State laws and regulations, which supplement department regulations.

Free area.—Those States or portions thereof which are not quarantined for foot-and-mouth disease.

On February 17, 1915, after the Chicago stockyards were found to have been reinfected and the disease appeared to have gained another foothold, a new feature in the quarantine orders was inaugurated termed a " restricted " area, which had for its purpose the restriction of the infection to the already infected States with a view of keeping the great western country and the Southern States free from the disease.

Restricted area.—Those portions of the quarantined area from which the interstate and foreign movement of cattle, sheep, other ruminants, and swine is permitted for immediate slaughter to points in the free and closed areas, or for any purpose to any point which is or has been in the quarantined area since October 1, 1914, other than in the designated closed area, and into which the animals may be moved for any purpose; also from which the interstate and foreign movement of the dressed carcasses of such animals, the hides, skins, wool, hair, horns, and hoofs of such animals, and of hay, straw, or similar fodder, manure, litter or bags or similar containers which have been used for stock feed is permitted without any restrictions whatever.

Prior to the adoption of the restricted area the States of Washington, Kansas, and Montana had received infected cattle from what had been supposed to be clean territory, and as a result it was necessary to eradicate the disease from the open-range country where it had spread to a number of native cattle. As territory was cleaned and disinfected succeeding orders permitted each section to be advanced from closed to exposed area, from exposed to modified, from modified to restricted, and eventually to free area. These advances were usually made at periods of 30 days each where no new cases of the disease developed.

APPRAISAL AND DISPOSAL OF ANIMALS

After the diagnosis of foot-and-mouth disease had been confirmed in each case the animals were appraised and arrangements made to dispose of the affected herd as soon as possible to prevent further spread of the disease. The methods of appraisal and disposal used in the 1914 outbreak and which are still in effect are as follows: Appraisals are usually made by two appraisers working together, one a representative of the State, the other the representative of the United States Department of Agriculture. Care is exercised in selecting appraisers in order to see that only men of proper temperament, good judgment, and who are familiar with the value of different classes of livestock are chosen for this duty. The digging of the trench is then commenced immediately (fig. 2). The owner of the affected herd if possible is induced to take the contract to dig the trench; otherwise a contractor is hired at an agreed price of so much per cubic yard. A lay inspector supervises the digging and is instructed to remain on the premises until the work is finished. It was demonstrated during this outbreak that the smaller trenches—those for herds not exceeding a dozen cattle—can be dug as quickly and more cheaply when picks and shovels are used than when teams, plows, and scrapers are employed. If the herd is small and the animals docile the ends and sides of the trench should be perpendicular. If the herd is large, time can be saved by sloping one or both ends of the trench so the animals can be driven into it and there slaughtered. The trenches should be 7 feet deep, 7 feet wide, and long enough to allow comfortable standing room for the cattle. Usually there is room in a trench of this size for the additional small number of hogs and sheep found on the average farm. Where there is an unusual number of hogs or sheep in proportion to the number of cattle more space is provided, allowing two hogs or sheep for each cow.

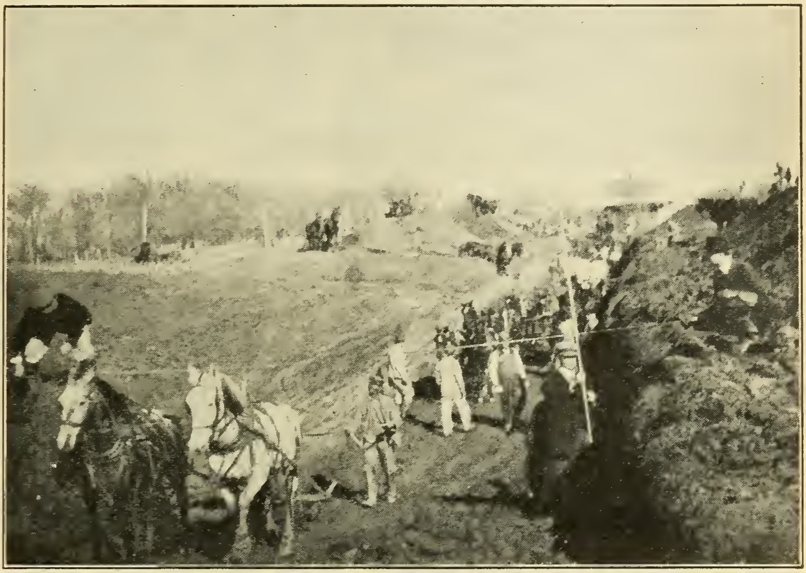


FIG. 2.—Digging a trench. Note method of measuring to insure proper depth

The slaughter of the animals is accomplished either by shooting them while they are standing on the fresh dirt at the side of the trench and then rolling them into it or by first driving them into the trench and shooting them there. The latter method is preferable in disposing of large herds, as considerable time and expense is saved and the surrounding ground is not contaminated with infection from escaping blood, saliva, etc. The handling and slaughter of condemned animals are done in the most humane manner possible.

After the carcasses are in the trench the hides are thoroughly slashed (fig. 3) and the abdominal cavity opened to allow the escape of the viscera. The carcasses are then covered with freshly slaked lime or quicklime (fig. 4). A barrel of lime for every 6 to 8 cattle or 12 to 15 sheep or hogs of the varying sizes usually found on farms is considered sufficient. If the animals are large, an addi-

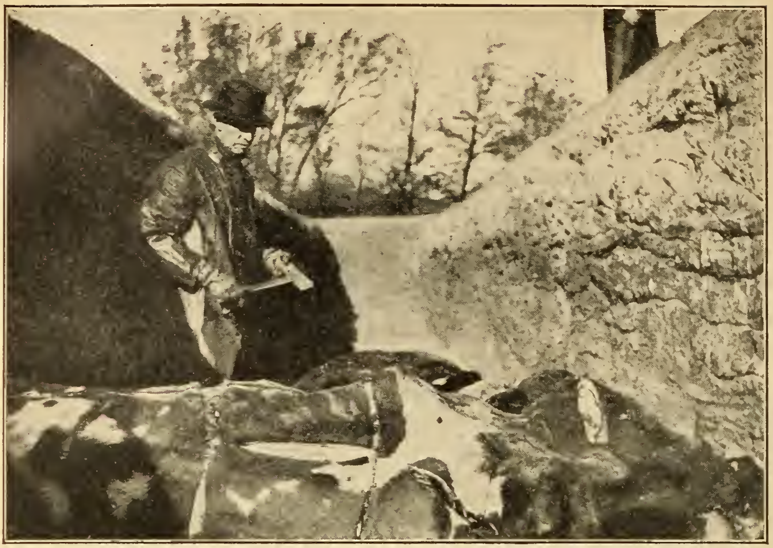


FIG. 3.—Slashing hides of animals in trenches. This operation frustrates any attempt to exhume animals to obtain their hides and also gives opportunity for lime to penetrate

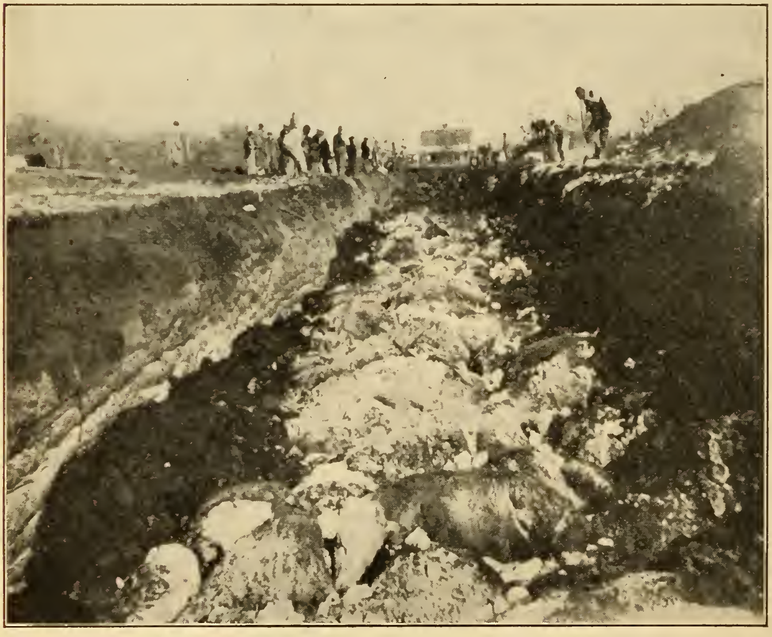


FIG. 4.—Applying quicklime to carcasses before covering with earth

tional proportion of lime is used. Since the carcasses are buried under a good depth of earth, a great deal of lime is not considered necessary. The trench is filled immediately after the animals are slaughtered, and a representative of the department or State is detailed to remain on the premises to supervise this work and the disinfection of the implements and clothing of all men when the work is finished, before they are permitted to leave the premises.

The slaughtering crew usually consists of one inspector in charge and three lay inspectors as assistants. The owner of the affected herd is expected to furnish additional assistance if it is required. During the 1914 outbreak four killing crews of this size disposed of as many as 28 herds in one day. A rifle of .25–20 caliber or some similar gun is a very satisfactory weapon for dispatching the animals.

CLEANING AND DISINFECTING PREMISES, ETC.

After the herd is slaughtered and buried, the infected premises are cleaned and disinfected without delay. A disinfecting crew consisting of an inspector in charge, a lay inspector assistant, and from seven to nine laborers has been found most satisfactory, efficient, and economical. The lay inspector assistant should be competent to take charge of the crew during the absence of the inspector in charge.

The inspector in charge of the disinfecting crew, his assistant, and the two nozzle men are supplied with complete rubber outfits, consisting of coat, boots, hat, and gloves. Overalls and jumpers are provided for the remainder of the crew. These outer garments are removed at the end of each day's work and left on the premises, and before moving to another farm or premises they are thoroughly disinfected. In order to hasten the work of the cleaning and disinfecting of infected premises, the inspector in charge of the disinfecting work precedes his crew for the purpose of planning the work in advance and inducing the owners to haul out the manure and clean the barns and other outbuildings preparatory to disinfection.

The usual supplies used in combating an outbreak of foot-and-mouth disease are dress-suit cases, rubber goods (fig. 5), such as boots, coats, hats, gloves, and fumigating capes, also sponges, permanganate of potassium, formaldehyde, bichloride of mercury tablets, compound cresol solution, chloride of lime, and pumps. Each pump is supplied with 100 feet of 3-ply steam hose and attachments, two spraying nozzles, and an extra supply of leather valves. Implements, such as shovels, forks, hoes, scrapers, picks, crowbars, axes, etc., are provided for use in connection with the cleaning of the premises before disinfection. The equipment also includes containers for carrying disinfectants enough for the day's work. Milk cans for liquid disinfectants and a tight sugar barrel for chloride of lime have been found satisfactory.

On arriving at infected premises the inspector in charge of the crew first makes an inspection to ascertain whether it is necessary to destroy any property in order to get rid of the infection. Only such property is destroyed as is necessary to rid the premises of infection. A record is made of all property destroyed, giving the measurements, kind, and quality. The owner or his representative is requested to be present when the measurements are taken or other record made of property destroyed, and before leaving the premises the inspector and owner jointly sign the report. This precaution is taken in order to avoid subsequent controversy in adjusting claims. On receipt of reports of property destroyed the inspector in charge of the station informs himself regarding the prices of hay, straw, lumber, etc., in the community where such property was destroyed, and in settling claims allows prices accordingly, making fair allowance for waste in replacing lumber and for hardware, etc.

Floors, mangers, stanchions, etc., are not destroyed if it is possible to disinfect them effectually for less than it would cost to tear them out and replace them. In disinfecting barns, stables, etc. (fig. 6), the condition of the lumber of which the floors, mangers, partitions, etc., are constructed, the time they have been exposed, and the opportunity for infection are taken into consideration, and it is also borne in mind that if the virus of foot-and-mouth disease can be reached by disinfectants it can be killed without destroying the lumber or other material that harbors it.

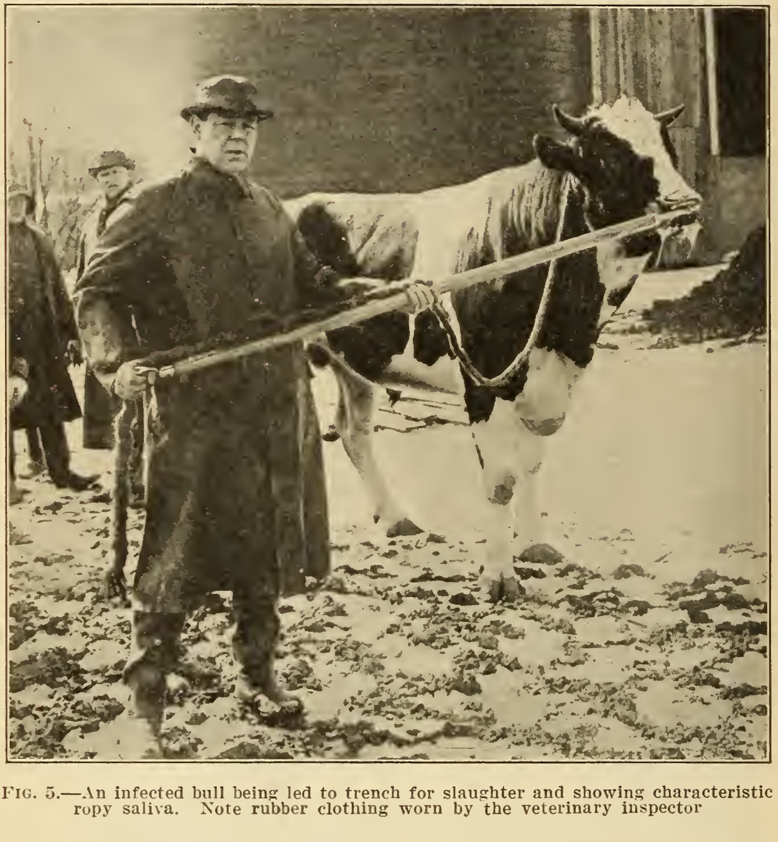


FIG. 5.—An infected bull being led to trench for slaughter and showing characteristic ropy saliva. Note rubber clothing worn by the veterinary inspector

Those portions of haymows, haystacks, and straw stacks that are infected from animals feeding from the sides or trampling upon such forage are removed by cutting or otherwise and the remaining surfaces raked, after which they are sprayed with a 4-per cent formaldehyde solution. The hay and straw removed from the infected stacks are burned.

When conditions permit, all the manure from the stables and from around the buildings, after it has been disinfected, is hauled out and spread in fields not accessible to animals susceptible to foot-and-mouth disease, preferably on fields to be plowed. If the weather conditions are unfavorable for spreading manure, it may either be hauled or piled and the surface forked over and sprayed with a disinfectant to a depth of from 6 to 10 inches. Manure that is hauled out and piled is covered with chloride of lime or unslaked lime, or a layer of 6 inches of uncontaminated horse manure, and fenced about with a pig-proof fence. After the removal of the manure the ground upon which it had lain is limed and left exposed for at least 60 days.

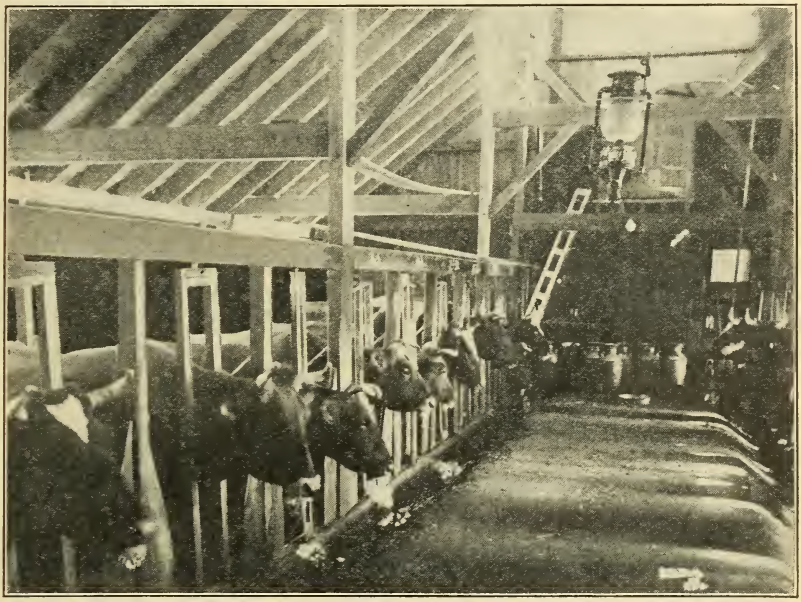


FIG. 6.—An infected herd showing typical mouth lesions. After a herd is slaughtered and buried, the next step is disinfection of premises. Dairy-barn interiors like this show the need of spraying outfits for applying disinfectants thoroughly

Disinfection can be most successfully and easily accomplished when the buildings have first been thoroughly cleaned. Therefore all litter and manure are removed from the barn floors, entries, feed rooms, and stables. Ceilings or other construction in stables are swept, dirt and dust removed from sills, mangers, and feed troughs, walls, and partitions swept, and the lower parts of partitions removed to facilitate the cleaning and disinfecting of floors. Those portions of posts, stanchions, etc., contaminated by infected saliva, are scraped or scrubbed with a hot solution of sal soda. Manure is removed from cracks between the floor planking, and badly decayed flooring is removed and burned. Where floors are in poor condition and have been exposed to the infection for some time, it is considered advisable to scrub them with a solution of sal soda before applying the regular disinfectant. It is not necessary to destroy the lumber unless it is badly decayed.

A spray pump is the most satisfactory and effective means of applying disinfectants to large surfaces, such as walls, ceilings, manure piles, haystacks, straw stacks, etc.

Care is exercised in selecting suitable disinfectants. A solution of formaldehyde is considered most suitable for hay, straw, harness, blankets, feed bags, lap robes, and finished surfaces of walls, ceilings, etc. Chloride of lime is very satisfactory for outside disinfection where there is plenty of air, as, for instance, manure piles, open sheds, stock pens, ground, etc., but the fumes are irritating and deleterious when used in closed buildings. Compound cresol solution or carbolic acid is most suitable in disinfecting stables, feed rooms, entries, etc. Formaldehyde gas is used for disinfecting dwellings, clothing, root cellars, milk houses, granaries, feed etc. Such articles as tie chains, halters, feed bags, cloth lap robes, harness, fly nets, etc., are dipped in the compound cresol solution, as it is practically impossible to reach all surfaces by spraying.

Dogs and poultry that have had access to infected stables, manure piles, etc., are dipped in a 2-per cent solution of compound cresol.

Railroad cars that have carried livestock in any quarantined area within 15 days of the date of an outbreak are cleaned and disinfected and all manure or litter removed from infected or exposed cars and stockyards is burned or disinfected.

INSPECTION OF NEIGHBORING STOCK

At least two and frequently four or five systematic inspections are made of all livestock in the neighborhood of infected premises. The first inspection commences as soon as the affected herd is discovered and extends for 2 or 3 miles in every direction from the infected premises. Not more than 15 days should intervene between the first and second inspections, the latter being extended to include all susceptible animals within a radius of 5 miles of the infected premises.

Each inspector keeps a record in a field book of all inspections made, which shows the name of each owner of animals inspected, number of animals of each species inspected, and the condition of the animals when inspected. The veterinary inspector detailed to make the second or subsequent inspections has with him a record of the previous inspections to guide him.

Inspectors detailed to make farm-to-farm inspections are each provided with a dress-suit case, rubber goods (including hat, coat, gloves, boots, and fumigating cape), thermometer, flashlight, bichloride tablets, permanganate of potassium, and formaldehyde. On reaching the premises where livestock is to be inspected they put on their rubber outer garments before or immediately on alighting from their conveyance, and thoroughly disinfect their rubber garments before leaving the premises (fig. 7). If foot-and-mouth disease is found, or any condition that indicates foot-and-mouth

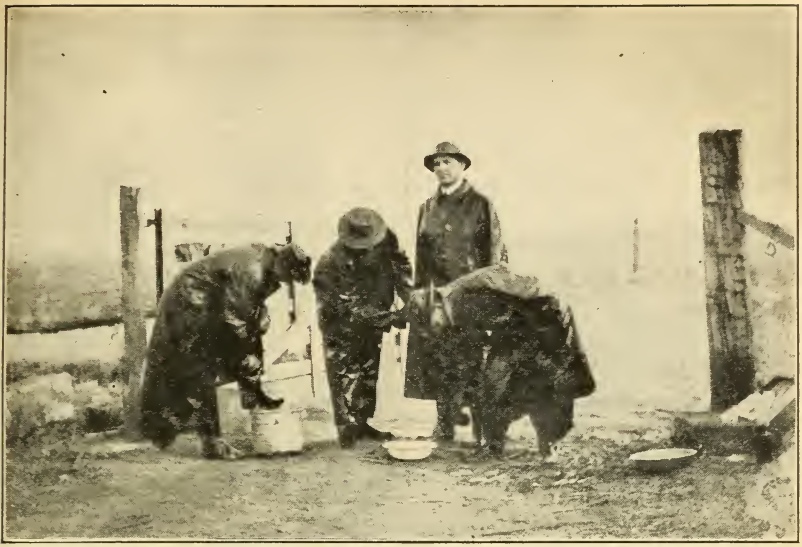


FIG. 7.—Inspectors disinfecting their boots and outer clothing, including gloves and hats

disease, the inspector in addition fumigates his clothing with formaldehyde gas before leaving the premises. The greatest care (fig. 8) is exercised to prevent carrying infection from diseased to healthy herds and to avoid criticism on account of apparent carelessness.

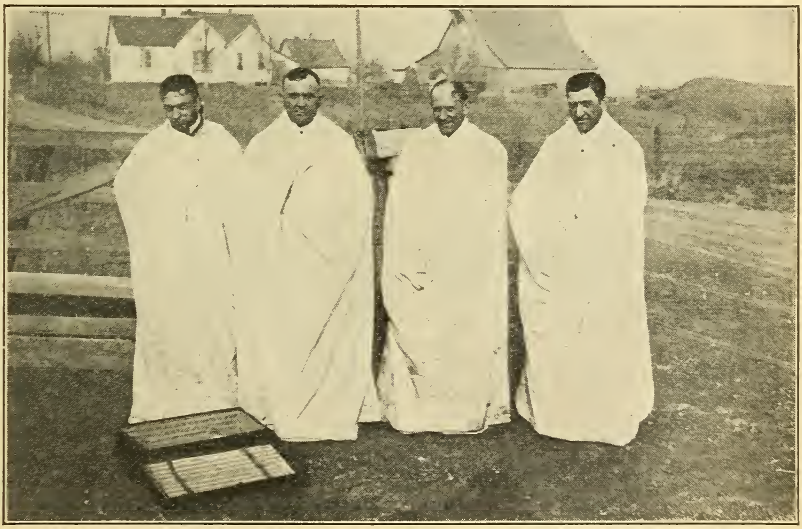


FIG. 8.—Fumigation in addition to disinfection is required before inspectors leave infected premises. Such care is responsible for the fact that in no outbreak of foot-and-mouth disease has any infection been spread from farm to farm by inspectors of the department

ADMINISTRATIVE DISTRICTS, REPORTS

Headquarters are centrally located wherever possible. When the outbreak extends over a large area, the territory is divided into districts and a substation established in each district. A competent veterinary inspector is detailed to take charge in each district. He is furnished with the necessary assistants and equipment and is held responsible for the efficient conduct of the work in his district. At the end of each day's work the inspector in charge of each substation makes a report to headquarters by telephone, telegraph, or otherwise, showing:

1. Number of new-infected herds discovered.
2. Number of herds slaughtered.
3. Number of herds awaiting slaughter.
4. Number of herds appraised.
5. Number of herds awaiting appraisal.
6. Number of trenches completed.
7. Number of trenches being dug.
8. Number of premises disinfected.
9. Number of premises where herds have been slaughtered and premises are ready for disinfection.

When this information has been collected for an entire district, the inspector in charge of the district forwards these facts in a night-letter telegram to the Washington officials for their information.

STATISTICS OF THE OUTBREAK

As a matter of interest, Table 2 is presented, showing various statistics of the 1914 outbreak by States.

TABLE 2.—*Statistics of foot-and-mouth disease outbreak of 1914*[1]

State	Counties		Herds slaughtered	Animals slaughtered					Appraised value of animals	Duration of outbreak
	Total[2]	Infected		Cattle	Swine	Sheep	Goats	Total		
Connecticut	8	3	35	701	175			876	$48, 366	November, 1914, to April, 1915.
Delaware	3	1	12	152	49	22		223	8, 068	November, 1914, to December, 1914.
District of Columbia			4	48	39			87	7, 139	November, 1914, to March, 1915.
Illinois	102	54	1, 226	31, 074	45, 560	1, 866	[3] 66	78, 566	2, 569, 102	November, 1914, to May, 1916.
Indiana	92	20	118	2, 437	3, 973	640		7, 050	179, 731	October, 1914, to August, 1915.
Iowa	99	9	49	1, 547	2, 335	32		3, 914	125, 297	November, 1914, to March, 1915.
Kansas	105	4	12	1, 218	313			1, 531	76, 097	February, 1915, to March, 1915.
Kentucky	119	11	82	2, 942	866	216	1	4, 025	135, 000	November, 1914, to June, 1915.
Maryland	24	10	70	1, 008	1, 784	313		3, 105	69, 038	November, 1914, to May, 1915.
Massachusetts	14	9	103	2, 066	6, 088	78	6	8, 238	217, 848	November, 1914, to October, 1915.
Michigan	83	16	272	2, 951	4, 108	818		7, 877	212, 334	October, 1914, to August, 1915.
Minnesota	86	1	1	25	35			60	2, 384	August, 1915.
Montana	31	3	42	1, 416	11	240		1, 667	67, 603	November, 1914, to January, 1915.
New Hampshire	10	1	3	78	26			104	4, 960	Do.
New Jersey	21	8	52	1, 315	815	9	6	2, 145	123, 387	November, 1914, to June, 1915.
New York	62	21	219	5, 737	625	150	33	6, 545	476, 578	November, 1914, to August, 1915.
Ohio	88	39	228	4, 069	5, 003	3, 070		12, 142	359, 971	November, 1914, to April, 1915.
Pennsylvania	67	34	892	15, 294	10, 634	368	10	26, 306	947, 958	Do.
Rhode Island	5	3	59	985	379	33		1, 397	71, 096	November, 1914, to March, 1915.
Virginia	100	3	9	378	650			1, 028	27, 744	Do.
Washington	39	1	1	102				102	4, 050	November, 1914.
West Virginia	55	3	27	194	189	148		531	12, 814	February, 1915, to April, 1915.
Wisconsin	71	12	40	1, 503	1, 435	1. 764	1	4, 703	119, 155	November, 1914, to May, 1916.
Total	1, 284	266	3, 556	77, 240	85, 092	9, 767	[3] 123	172, 222	5, 865, 720	October, 1914, to May, 1916.

---

[1] Exclusive of dairy-show herds, which were not slaughtered and which are fully discussed on page 5.

[2] The number of counties in each State is given in order to show, by comparison with the number infected, the approximate area involved.

[3] Including 9 deer

PREVENTION OF FUTURE OUTBREAKS

Veterinarians in all branches of the profession should constantly be on the lookout for foot-and-mouth disease. Notwithstanding the department has always taken every practicable precaution to eradicate the infection and to prevent the introduction of the disease into the country, the infection may recur or again be introduced from abroad. If in the examination of animals any condition is found that arouses suspicion of foot-and-mouth disease, a careful inspection should be made of the mouth, feet, teats, udder, and perineum for specific lesions of the disease (figs. 9–13). The only specific lesion is the vesicular eruption, but next in order of importance in diagnosing the disease is the erosion, showing abrupt borders which cause it to present a punched-out appearance. Temperatures of all animals in the herd should be recorded.

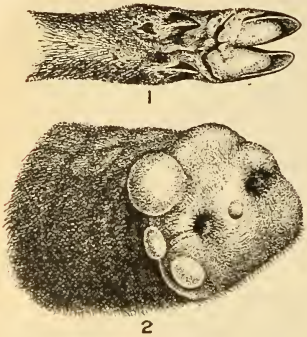


Fig. 9.—Foot and snout lesions of hog infected with foot-and-mouth disease. (After Kitt.)

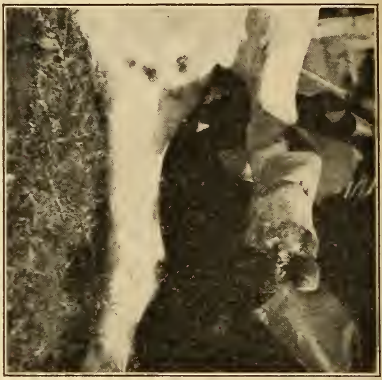


Fig. 10.—Foot lesions of the disease. Note blister in cleft of hoof

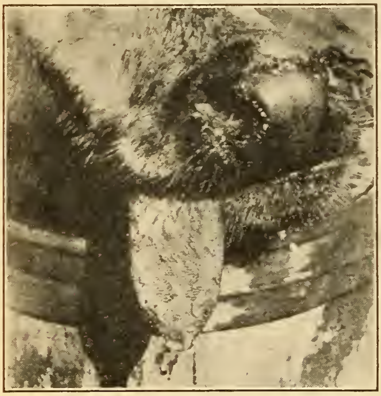


Fig. 11.—Characteristic tongue lesions of foot-and-mouth disease. Note numerous ulcers

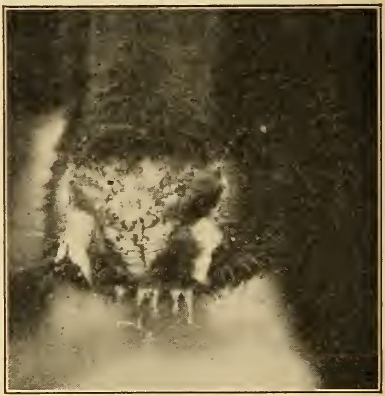


Fig. 12.—Discharges from the nostrils are of frequent occurrence in foot-and-mouth disease

The examination should not be confined to the suspicious animals, but should include all susceptible animals of different species on the farm, and if the suspicion of foot-and-mouth disease is strong the inspection should extend to animals on adjacent farms. The number of animals affected and a description of the lesions should be noted. Special inquiry should be made into the history of the condition, and all information available should be considered with the view of ascertaining whether there is any evidence of contagion.

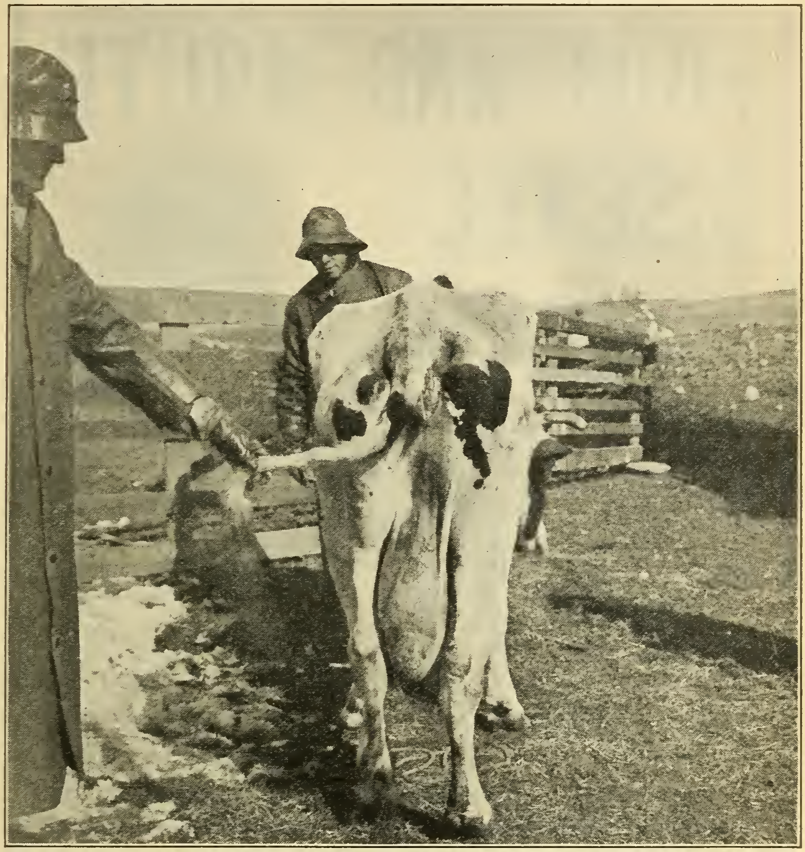
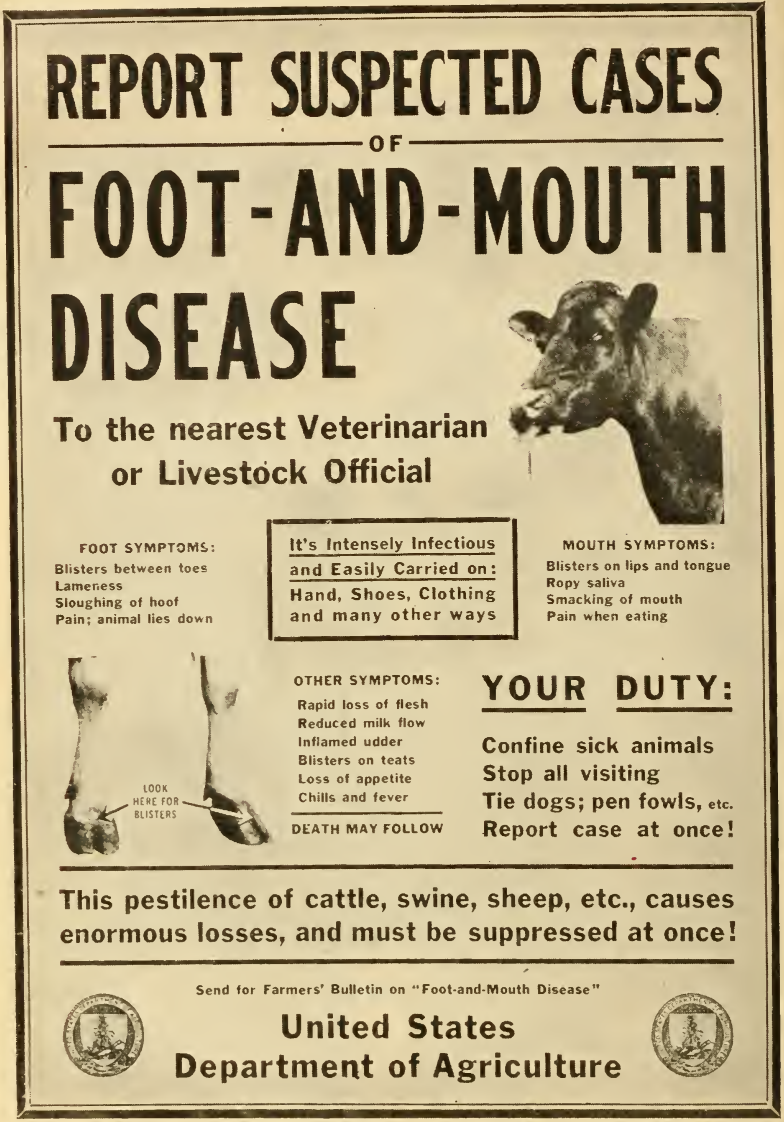


FIG. 13.—A severe case of mastitis (garget), one of the frequent aftereffects of foot-and-mouth disease

In all cases, even when there are only slight grounds for suspicion of a new outbreak of foot-and-mouth disease, the matter should be promptly reported by wire to the chief of the Bureau of Animal Industry and the State veterinarian and a detailed written report should be forwarded as soon as possible. This report should include a description of the lesions and their location, the number of susceptible animals of each species on the farm, and the history, including the evidence, if any, of contagion. At the same time there should be forwarded to the department, in tightly sealed containers, material immersed in equal parts of glycerin and boiled water, for microscopic and inoculation purposes. This material should include the contents of vesicles where available, and where this material is not available, specimens from the freshest erosions or ulcers should be forwarded.



REPORT SUSPECTED CASES

OF

FOOT-AND-MOUTH DISEASE

To the nearest Veterinarian
or Livestock Official

FOOT SYMPTOMS:
Blisters between toes
Lameness
Sloughing of hoof
Pain; animal lies down

It's Intensely Infectious
and Easily Carried on:
Hand, Shoes, Clothing
and many other ways

MOUTH SYMPTOMS:
Blisters on lips and tongue
Ropy saliva
Smacking of mouth
Pain when eating

LOOK HERE FOR BLISTERS

OTHER SYMPTOMS:
Rapid loss of flesh
Reduced milk flow
Inflamed udder
Blisters on teats
Loss of appetite
Chills and fever

DEATH MAY FOLLOW

YOUR DUTY:

Confine sick animals
Stop all visiting
Tie dogs; pen fowls, etc.
Report case at once!

This pestilence of cattle, swine, sheep, etc., causes enormous losses, and must be suppressed at once!

Send for Farmers' Bulletin on "Foot-and-Mouth Disease"

United States
Department of Agriculture

FIG. 14.—Poster used by the department as an educational measure in acquainting stockmen with the nature of the disease and the necessity of suppressing it

In all instances where a positive diagnosis can not be made, but where there is suspicion of foot-and-mouth disease, veterinarians should proceed immediately without waiting for a reply to their report to make inoculation tests on hogs, calves, and horses, in order to ascertain whether the disease is transmissible. Further information on symptoms, lesions, differential diagnosis, etc., may be found in Farmers' Bulletin 666, as well as in other standard works on foot-and-mouth disease.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

August 25, 1924

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